HYDROGENERATEUR RACING
Instruction manual

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HYDROGENERATOR SERIAL NUMBER

CONVERTER SERIAL NUMBER

HYDRAULIC PUMP SERIAL NUMBER

CONGRATULATIONS

You own the most powerful hydrogenerator of its kind. Designed for transoceanic racing and cruising, this device will drastically change your energy management at sea and become your main source of power while sailing.

Conceived and built in France by :

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1. SAFETY NOTICE

"Safety first" was our goal in building the hydrogenerator. However precautions must be taken as when using any mechanical or electrical device.
Keep in mind safety rules when installing and operating the hydrogenerator. Be aware at all times of hazards in operating the propeller.

1.1. Mechanical hazard

While rotating, the propeller blades present the largest mechanical risk. They are made from stainless steel and their outer edge can rotate at up to 62 MPH (100km/h).
At this speed, the blades are nearly invisible and can cause serious injury. Under no circumstances should you install the turbine where a person could come in contact with the moving rotor blades.
Similarly, due to the ideal hydrodynamic profile of the blades, the trailing edge is very thin and may be sharp.

WARNING: THE TRAILING EDGES OF THE ROTOR BLADES ARE SHARP AND MAY CAUSE INJURY WHEN ROTATING AT SPEED.

WARNING: WHEN PLACING THE HYDROGENERATOR, MAKE SURE THAT THE PROPELLER IS NOT WITHIN EASY REACH.
DO NOT ATTEMPT TO STOP THE PROPELLER WITH YOUR HAND WHILE THE DEVICE IS WORKING.

1.2. Electrical hazard

Heat in wiring systems is often a result of too much current flowing through an undersized wire or through a bad connection.
Batteries conduct very high intensity. A short-circuit in the Battery cables may cause a fire. A fuse placed into the converter prevents this issue. In the event of a failure of the fuse, you must first identify the cause of the failure, before replacing the fuse with it's equivalent.
For the fuse change procedure, refer to chapter 5.5.

WARNING: FUSES MUST BE REPLACED WITH AN EQUIVALENT TO THE ORIGINAL MODEL.

WARNING: ALWAYS RAISE THE HYDROGENERATOR UP BEFORE WORKING ON IT

1.3. Installation

Please follow our safety guidelines during installation:

- Keep safety in mind - Get helps.
- Connect the batteries last.

1.4. Operation

- Check the support structure, blades and electric circuit on a regular basis.
- Propeller blades are very sturdy though they might warp or break when running up against a hard-immersed object.
-

WARNING: NEVER TOUCH THE PROPELLER BLADES WHILE THEY ARE SPINNING.

WARNING: NEVER USE THE HYDROGENERATOR AS A LADDER STEP BECAUSE THE SHAFT MAY WARP.

WARNING: ELECTRIC CONVERTER REACHES HIGH TEMPERATURE WHILE OPERATING.

2. PACKAGE CONTENTS

Check the package content against the list below.

1 HYDROGENERATOR RACING
1 CRADLE
1 KIT FOR PROPELLER BLADES
1 CONVERTER 12V OR 24 V + 2M of 10 mm^2
battery cable
1 FIXATION KIT (2 Plates + 2 SS bolts)
1 COTTER PIN
1 INSTRUCTION GUIDE

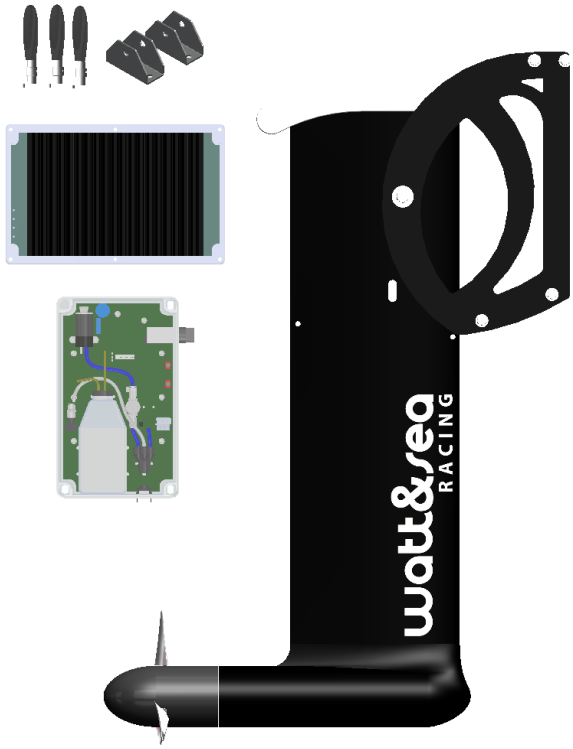

Figure 1 : Package contents

3. TOOLS & SUPPLIES REQUIRED

- 3 phase cable 3x2, 5mm^2 minimum to connect the hydrogenerator to the converter
- RS485 (3x0,5 mm2) cable for the databus between the converter and the pump
- Quick Disconnect Terminals Ø 6.35mm (blue)
- Crimp pliers
- Terminals for battery connecting cables 10mm^2 or 6mm^2 (depending on converter model)
- Connectors for 3-phase cables
- Outlet box PVC
- Metric Allen wrench set
- Hubs & screws for the pump converter
- Gasket Ø 6mm
- Hydraulic tube polyamide 6x4mm (for example LEGRIS 1025P0601)
- 6mm T junction if multiple hydrogenerators (for example LEGRIS 3104 06 00)
- High performance Mineral Oil (type FUCHS Renolin Extra 22 S – minimum volume = 350 mL)

4. MECHANICAL INSTALLATION

Your hydrogenerator is shipped partly as a kit. Refer to the assembly drawing below, and follow the instructions. Please read carefully the instruction manual before proceeding to the installation.

4.1. Installing the propeller blades

- Remove the propeller cone (11), then the propeller blades support (10); pay attention to the spacer spring inside the shaft.
- Grease the hub slots and the blades.
- Clip the blades into their respective slots in the hub. The mounting lug must be positioned behind the piston triangle (12).
- Remount the propeller blades support, with a moderate torque on the 3 screws CHC M5. Then, remount the cone with similar moderate torque on the CHC M5 screw. The blades must rotate freely inside their slots.

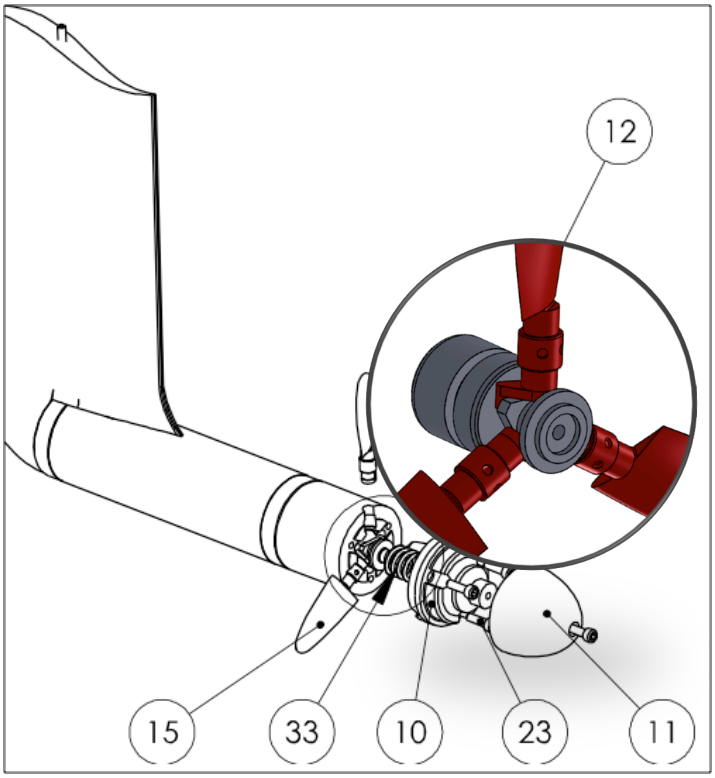

Figure 2: Exploded view of the prop shaft

N	Description
10	Propeller blades support
11	Propeller cone
12	Piston
15	Propeller blades
23	Screw CHC M5x30 (4x)
33	Spacer spring

4.2. Placing the device on the transom

Choosing the right place for the device is crucial to optimize its performance. Be careful to respect the following conditions :

- **Immersion depth:**

The recommended depth from surface to propeller axis is 30cm (12 inches). The machine comes with a profiled 0.61-meter aluminium fin that can be cut to fit any configuration. The deeper the device is located and the farther the propeller is from the hull wake, the better it is.
However, the deeper the boom is, the more stress on mounting will result. In addition, the device will be harder to lift.
We consider that a length of 0.61 meter is a satisfactory compromise that suits most installations on multihulls because they don't lean, or on very wide mono-hulls when a device is installed on each side.

- **Flow quality:**

A good water flow is crucial to a good output.

NOTE: do not place the device in close proximity to the wake of a rudder or to a saildrive.

Whenever possible, offset the device several inches off to the side of the centerline, or off to the side of the rudder.

- **Examples of installation:**

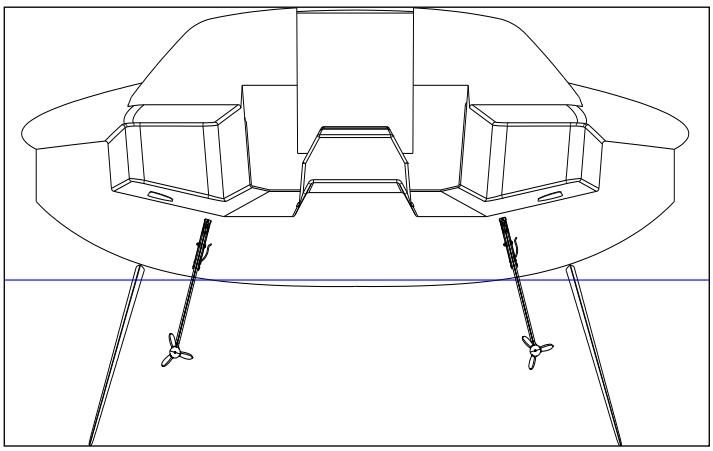

Figure 3: Double installation on a Pogo40

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The hydrogenerators were placed parallel to the rudders, but with a 30cm offset to avoid the wake.

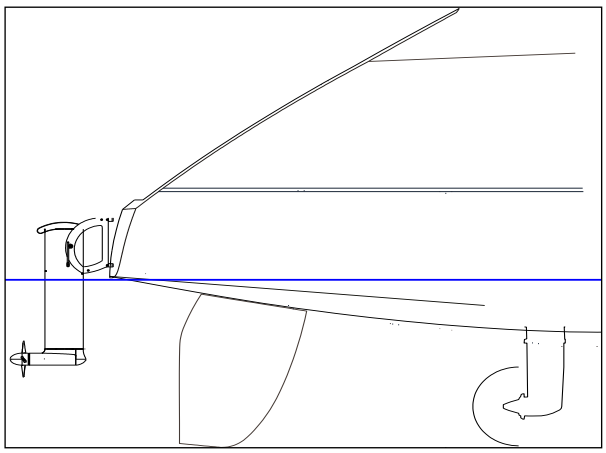

Figure 4: Installation on a catamaran

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The hydrogenerator is placed parallel to the rudder but off its wake.

4.3. Installing the cradle on the transom

Depending on your transom structure and to ease stress on the cradle plate, you might need to reinforce the structure of the transom.

WARNING: Because the lever arm is important, the maximum effort in cradle's fixations is around 300 kg (661 pounds). Your mounting system should be designed accordingly.

The cradle must be fastened to 8mm chain plates that will be securely mounted on the transom.
Chain plates must be placed vertically.
Use the drawing below to adapt the mountings to your boat.

NOTE: when immersed in working position, the shaft must be vertical.

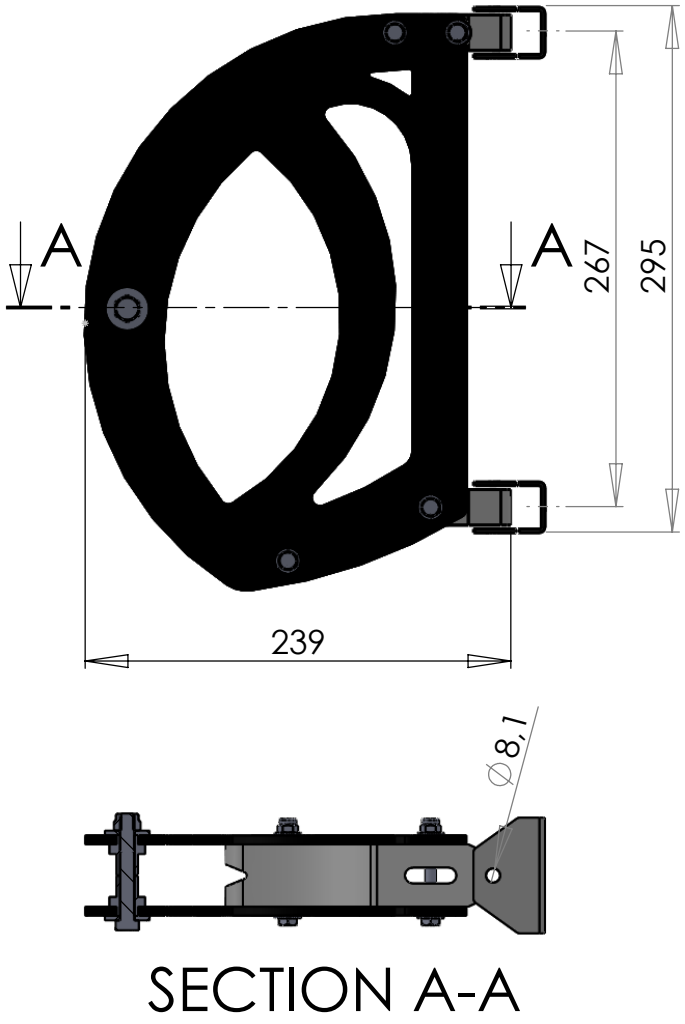


Figure 5 : Cradle dimensions

4.4. Running a line of the immersion/lifting system

Your hydrogenerator comes with a lifting system designed after lifting rudders systems.
It allows easy access to the propeller when the device is in upper position, which allows weed cleaning without leaning over board.
We recommend inserting a self-release clam that will release the device when running against an immersed hard object.
Immersion and lifting are performed with 2 lines attached into specific eyelets

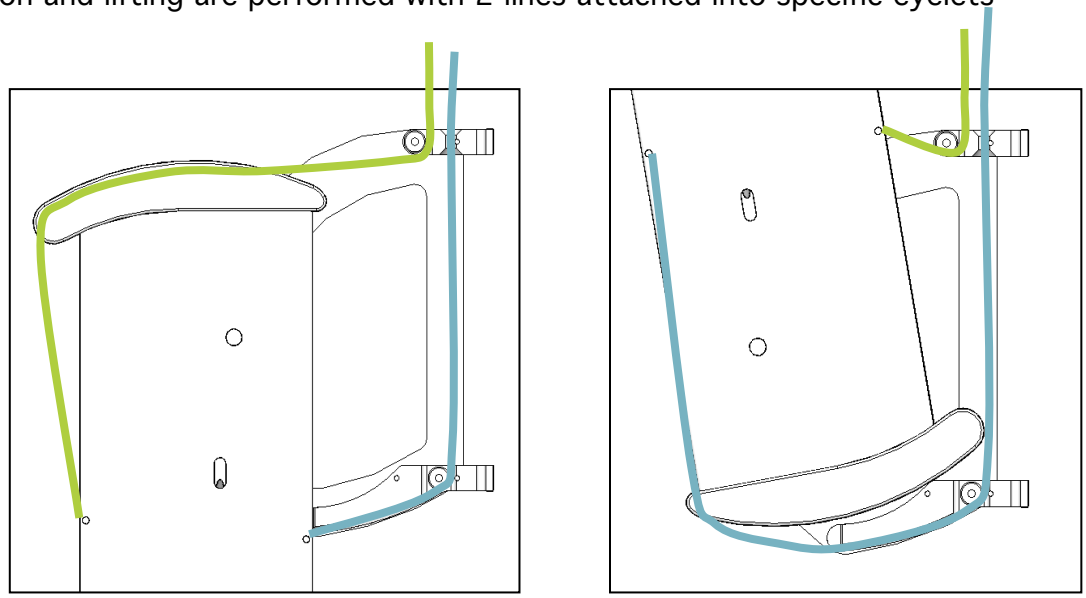


Figure 6 : Immersing/lifting lines path

Lifting weight is around 40 kg (88 pounds). We recommend to placing a 4:1 pulley hoist for easier lifting of the device, and a 6:1 for the lowering line on the cruising model.

NOTE: When the hydrogenerator is immersed, the leg must be blocked in the throat done for this purpose. If not, some mechanical deterioration could appear.

Figure 7 : Device lifted in upper position

4.5. Mounting the electronic converter

The electronic converter is fitted into a waterproof box that features passive ventilation allowing long durability of the device in a humid environment.

However this converter must be affixed inside the boat, preferably near the battery to be charged.

WARNING: THE CONVERTER CAN REACH A HIGH TEMPERATURE WHILE OPERATING. TAKE THIS INTO CONSIDERATION FOR ITS INSTALLATION

NOTE: To allow proper ventilation, the converter must be mounted on a vertical bulkhead, with ventilation grids in vertical position

Once a proper place is designated, follow this procedure:

- Drill 4 holes using the provided template (Fig10)
- Remove the cover (6 M6 screws)
- Secure the device in place with the appropriate screws
- Put the cover back in place with its gasket.

NOTE: Carefully put the gasket back in place

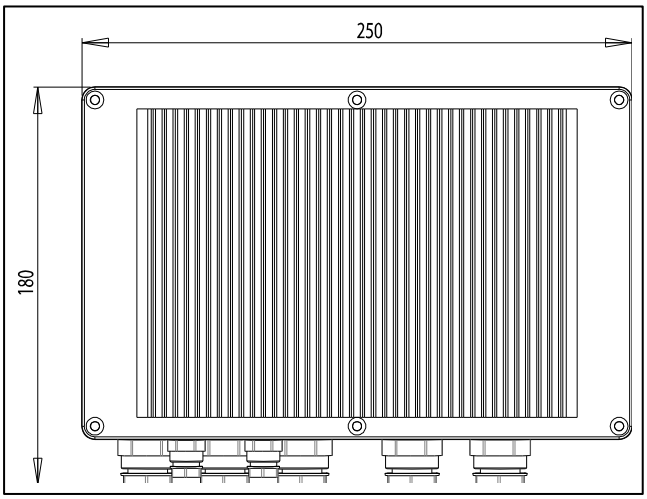


Figure 8 : Converter dimensions

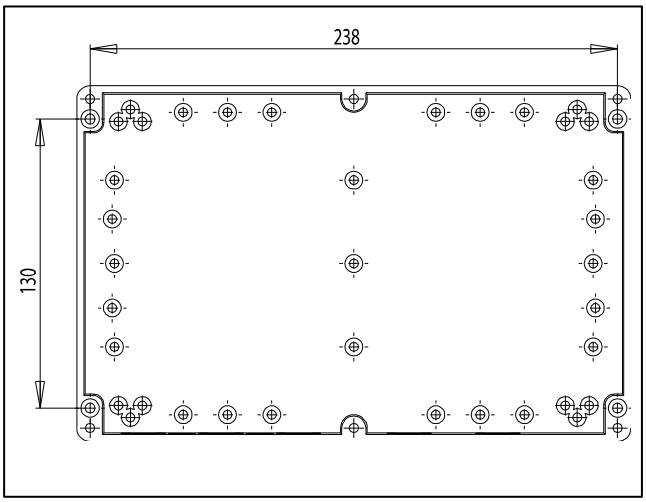


Figure 9: Drilling template

4.6. Mounting the hydraulic pump

The hydraulic pump is delivered in a waterproof casing that contains the electrical panel, the pump and it's oil tank. Two switches located on the side of the pump allow an easy manual control of the blade's position.

The casing must be placed vertically, if possible near the converter and in an accessible location.

Note: The casing of the pump must be placed vertically.

Once the location is chosen, follow the procedure below:

- Pre-drill 4 holes using the template provided (212x122mm)
- Open the lid by removing the 4 screws
- Screw the waterproof casing into place, then re-place lid

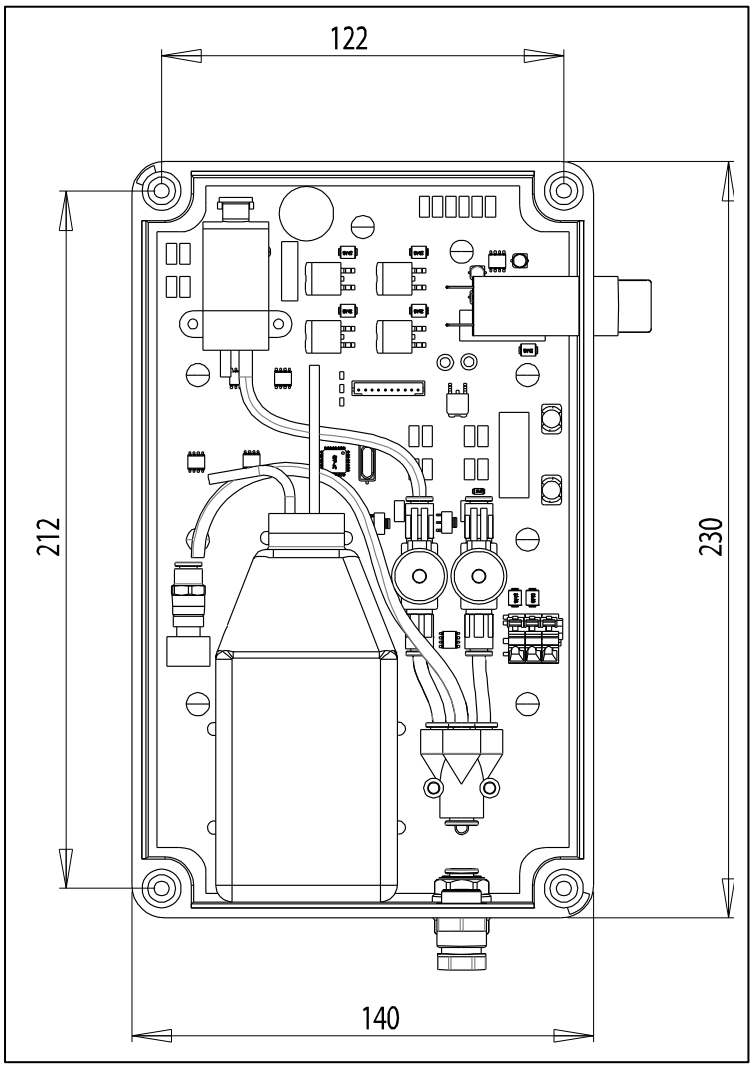


Figure 10: Dimensions of hydraulic pump

5. ELECTRICAL INSTALLATION.

Recommendations regarding electric connections:
- Please follow all local/national safety rules before installation.
- All electric cables must be carefully insulated. For the highest safety, run cables through plastic conduits.

WARNING: CONNECTIONS MUST BE CHECKED ON A REGULAR BASIS TO DETECT ANY EVIDENCE OF CORROSION, AND CLEANED WHEN NECESSARY.

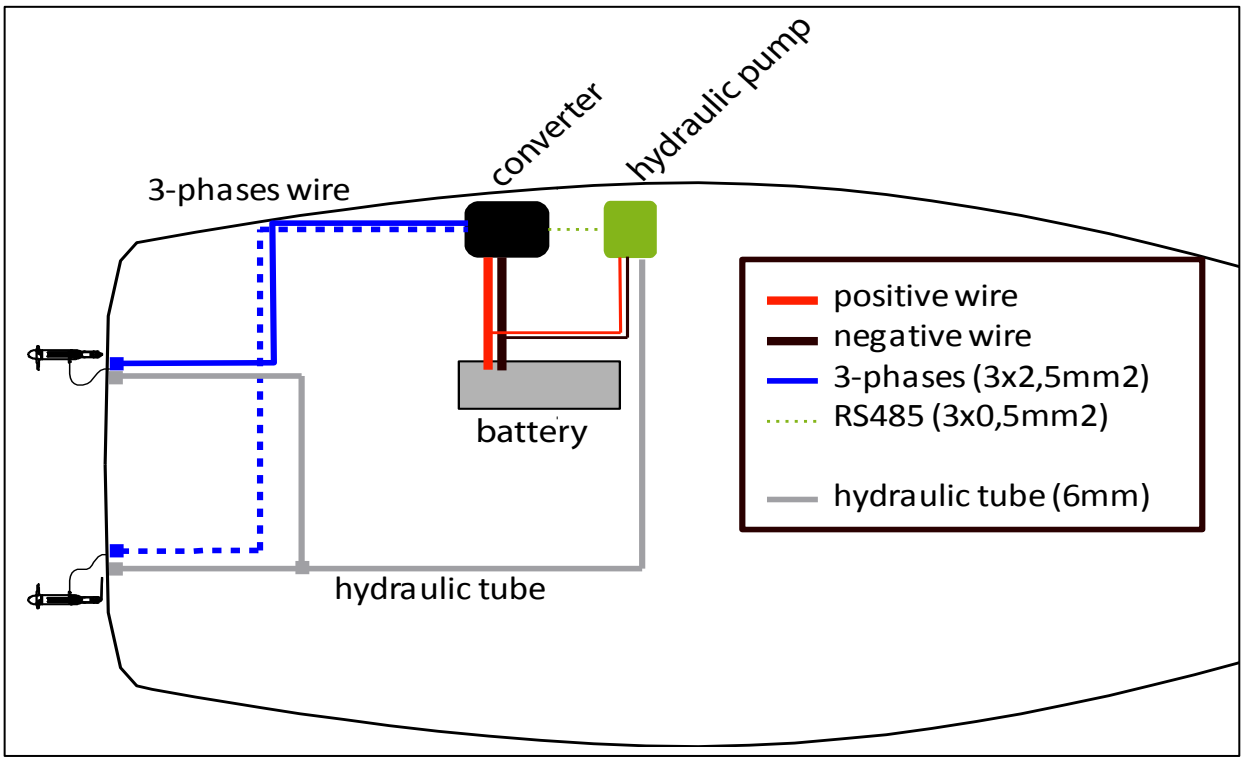


Figure 11: Wiring schematic

Unit conversion :
2,5mm² ~= AWG 13
0,5mm² ~= AWG 20
6mm ~= 1/8 “

5.1. Three-phases wiring of the hydrogenerator

WARNING : LIFT THE GENERATOR UP BEFORE ANY OPERATION.

The hydrogenerator comes with a small diameter electric cable located at the bottom, long enough to get through the transom. This cable features a 3-phase wiring identified in black, brown and grey colours. A green & yellow wire can be found for ground.

- We recommend the installation of a gasket diameter 6mm on the cable going through the transom

- After this transom point, connect a tri-phase cable of a larger section (minimum 3X2.5mm2) between the hydrogenerator and the converter.

NOTE: a cable of a smaller section than 3X2.5mm2 will affect the output of the device as well as its performance.

- We recommend connecting the cables in a designated outlet box inside the boat to allow a better prevention against corrosion.

You may use this kind of connector that absorbs well vibrations and features a quick release connexion: WAGO 222-412

- The converter is connected with Quick Disconnect Terminals (Fast-on) of 6.35mm. First open the converter box, pass the tri-phase cable through the gasket hole, then crimp the Quick Disconnect Terminals and connect them to their terminals.

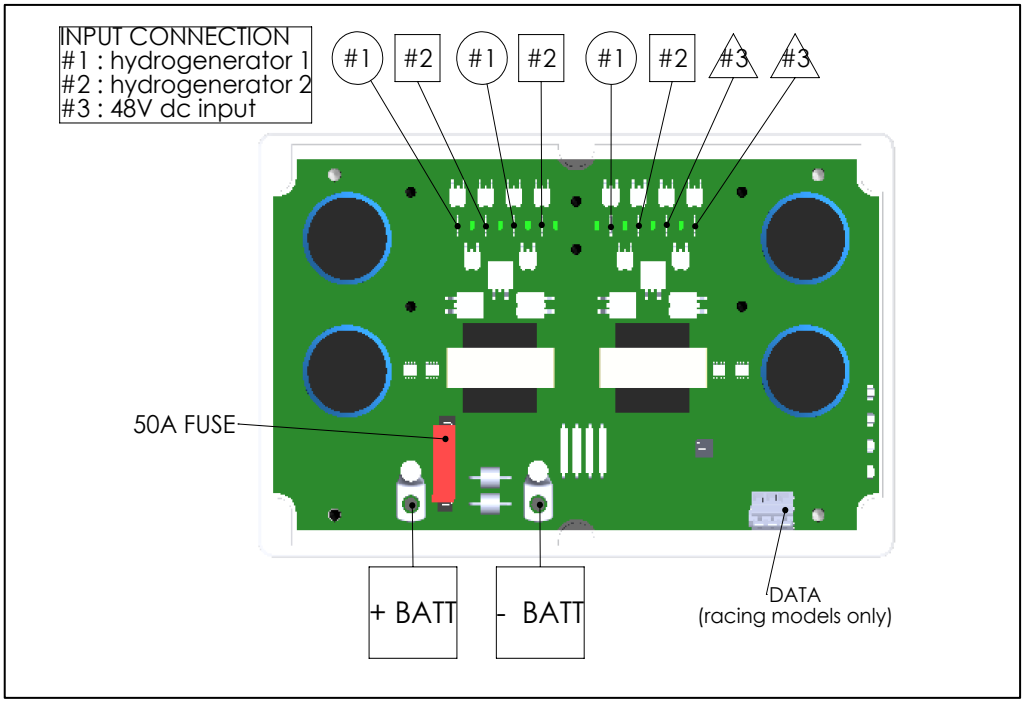


Figure 12 : Phase converter wiring plan. Arrows indicates phases in.

NOTE : The converter is equipped with connections for 2 hydrogenerators and an auxiliary 48V Input, so far 8 terminals.

NOTE: phase order for each hydrogenerator is free. The user has not to take into account the colours of the cable. The connection of the three phases of each hydrogenerator has to be done as defined in Figure 12.

5.2. Connecting the converter to the batteries

The converter must be placed as close as possible to the batteries to minimize losses from cable length. We provide 2 meter long connecting cables for batteries.

We recommend shortening any extra cable to reduce losses.

If the installation needs an overall distance of more than 2 meters (6 feet), extend the cables with wider section ones, or replace them entirely with wider section cables.

We recommend connecting the hydrogenerator directly to the battery bank on its proper terminal. The converter of the hydrogenerator will charge the batteries when needed.

Connecting the hydrogenerator through a hub is possible if charging several battery compartments is needed. Nevertheless those systems affect the output and a loss of about 5% will result.

An electric arc might occur when connecting: this is normal, due to the charging of the condensers into the converter.

WARNING : respect the converter polarity: positive from converter to battery positive, and converter negative to battery negative.
Inverting the polarity will result into the fuse to blow, and might ruin the device itself.

5.3. Connecting the hydraulic pump to the batteries

The hydraulic pump must be placed in an accessible position, with good access to all the switches and the oil gauge.

The battery power supply is connected to 2 terminals Fast-On 6.35mm labeled “+bat” for the positive terminal and “-batt” for the negative terminal.

Check the correct functioning of the device by putting it in “manual” mode, and activate “pump”. The pump must turn under the manual impulse.

WARNING : DO NOT RUN THE PUMP DRY FOR MORE THAN 30 SECONDS.

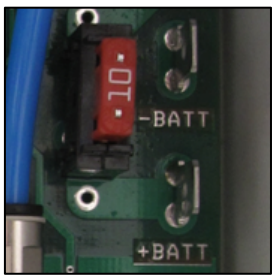


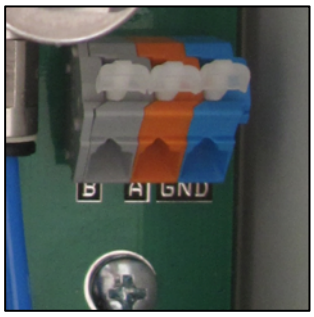
Figure 13 : Mini Fuse 10A

Figure 14 : Pump switches

5.4. Connecting the RS485 Bus

The converter and the hydraulic pump communicate through an RS485 Bus. The RS485 regulates the inclination of the propeller blades, when the automatic mode is switched on.

The Bus contains 3 wires, designated A, B, and GND. They must be connected to terminals inside the converter housing and pump housing; the terminals are also labeled A, B, and GND.



Once the Bus is correctly connected, a green LED inside the pump housing will blink at 3x per second.

5.5. Replacing the fuse of the converter and the hydraulic pump

A maxi auto fuse, grade 50Amp, protects the 12V converter.
A mini auto fuse, grade 25Amp, protects the 24V converter.
A mini auto fuse, grade 10Amp, protects the hydraulic pump 12V and 24V

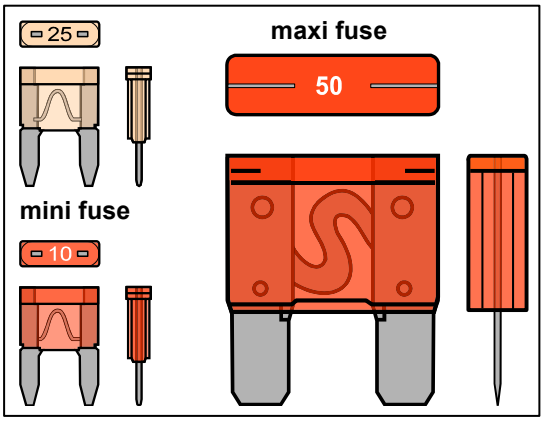


Figure 15: Type of fuses use

When a fuse blows, you should first figure out the source of the problem and solve it before replacing it.

How to replace a fuse:

- Disconnect the converter from the batteries
- Open the cover
- Replace the fuse
- Reconnect the batteries

6. HYDRAULIC INSTALLATION

The hydraulic pump controls the pitch of the hydrogenerator blades.

The pump is designed to be matched to a polyamide tubing, exterior diameter of 6mm (~1/4“) (for example LEGRIS 1025 01).
In order to connect multiple hydrogenerators to the same pump, you must use a T-junction, diameter 6mm (for example LEGRIS 3104 00)

P06

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The quick-release couplings can be used without tools. First, depressurize the circuit, then push the ring in and slide the tube out. The tube must slide out easily.

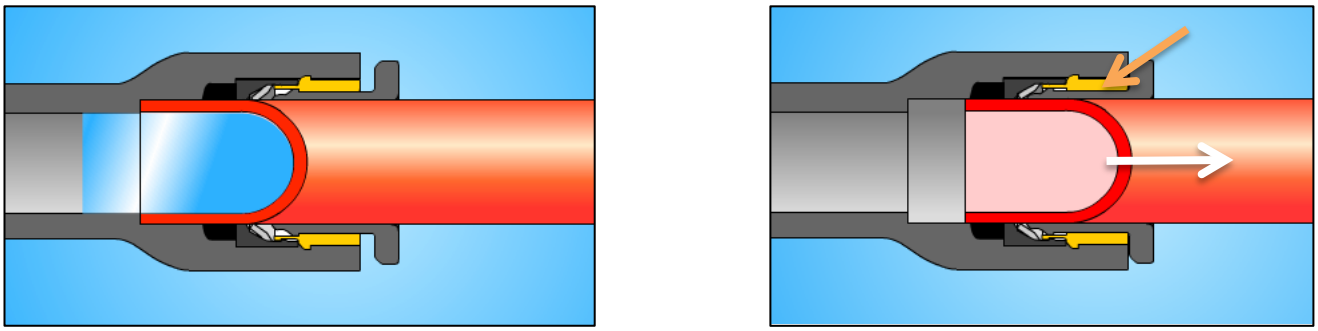


Figure 16: Disconnecting the quick-release couplings

(© LEGRIS)

The pump housing contains a hydraulic micro-pump, a check-valve, a solenoid and a digital pressure gauge

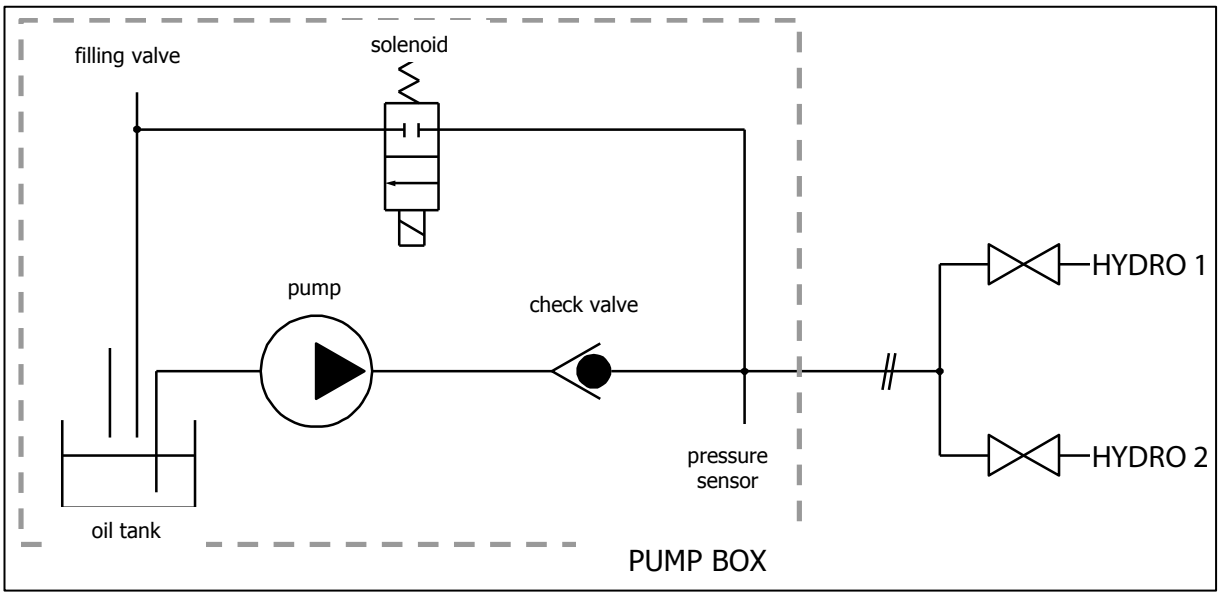


Figure 17: Hydraulic circuit blueprint

6.1. Connecting the hydraulic circuit

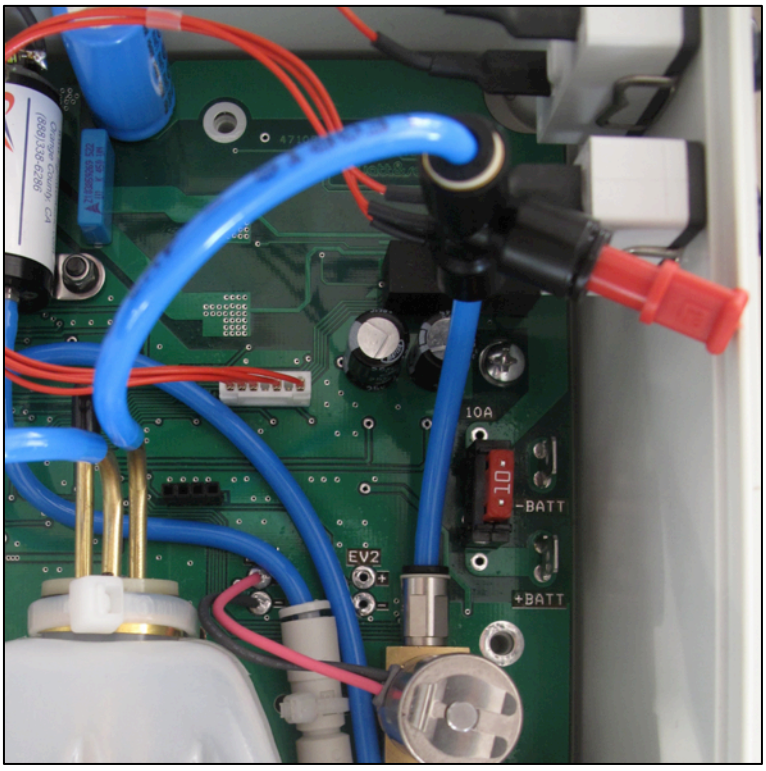
Thread the hydraulic tubing from the transom to the pump.
Connect the pump to the circuit with the quick-release couplings located on the lower section of the housing.

Note : At this point, do not connect the hydrogenerators

6.2. Filing the oil reservoir and bleeding the circuit

Place a bucket to collect the oil that will be drained during the bleeding process.

Fill the oil reservoir with mineral oil (low viscosity type FUCHS Renolin Extra 22 S). To fill the reservoir, remove the filler cap and use a large caliber syringe.
When the reservoir is full, bleed the circuit, using switch in manual and “pump” mode.



Cap

Figure 18: Oil filler cap

When you have finished bleeding the circuit, you can connect the hydrogenerators and top up the oil level.

Fill the oil reservoir to ¾ capacity, in order to leave a margin for the good functioning of the device during operation.

Verify in manual mode that the blades rotate and adjust correctly when following the preset commands.

7. CHARACTERISTICS

7.1. Technical characteristics

- **Hydrogenerator :**

Nominal power : 500W
Voltage : 3-phase 40V
Current : 9A
Weight : 8,5kg

- **Hydraulic Pump :**

Voltage : 12V or 24V
Tank capacity : 300mL
Max Pressure : 7 bars
Weight : 1 kg

- **Converter :**

Nominal power : 500W
Regulated voltage ABS : 14,3V or 28,6V
Floating voltage : 13,8V or 27,6V
Current : 40A or 20A
Weight : 3,5kg
Dimensions : 250 x 180 x 130 mm
(10.2 In x 7.1 In x 5.1 In)

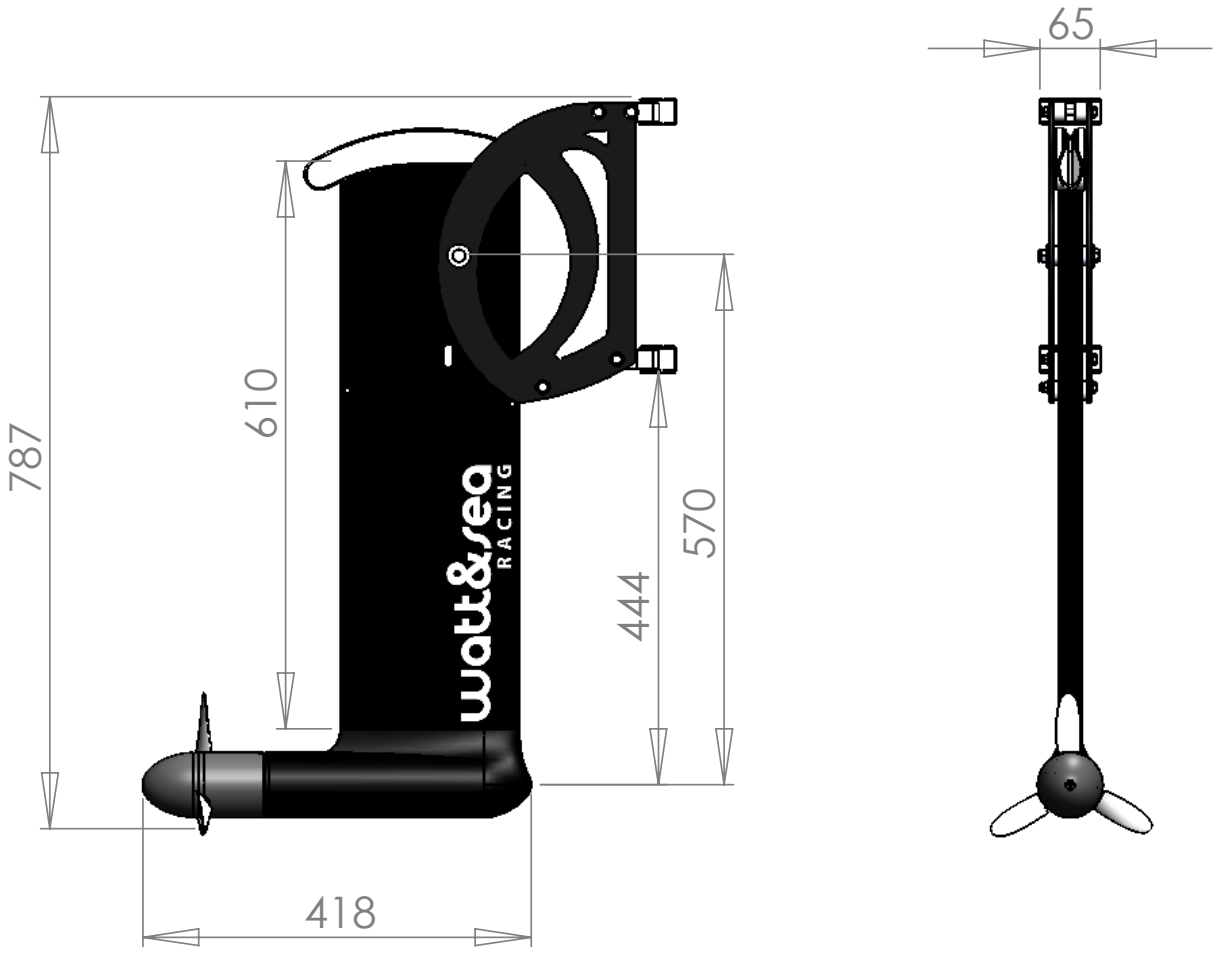


Figure 19: Racing hydrogenerator dimensions

7.2. How it works

- **The hydrogenerator :**

It includes a permanent magnet alternator producing very low 3-phase current (0-40V). This technology allows high efficiencies, but also generates high voltage during over-speed. To prevent tension from surging over 40V, an electronic protection cuts off the voltage above 40V. This circuit is imbedded into the body of the hydrogenerator, and thus protects the output.

- **Protection against overvoltage, some notes :**

When the device works over-speed, it produces a specific and audible rumble. This can occur for several reasons:
1 – A cable has been disconnected or the fuse blew and the converter is not anymore linked to the batteries. The device runs 'freewheel' and is not slowed down anymore by the electromagnetic force.
2 – Batteries are charged or the battery capacity is too weak. The converter has completed charging the batteries or the batteries can't absorb enough energy to slow down the propeller.
3 – The boat sails over the propeller speed range and the converter is stuck to its maximum capacity. If the additional drag and the resulting sounds that come with it don't bother you, you can keep on going.

- **Signification of converter's LEDs :**

The converter is equipped with 4 LEDs providing information below:

LED	Name	Description	ON	Twinkling	OFF
#1	BATT	Presence of the battery	Ubatt > 11.7V	9 < Ubatt < 11.7	UBATT<9V
#2	IN	Presence of the converter	Ualt > 0	N/A	Ualt = 0
#3	FLOAT	Load mode	FLOAT mode	ABS mode	Ualt = 0
#4	ERR	Warning	N/A	Alarms system or low tension of the battery	Nothing to announce

- **Regulation of the wedging :**

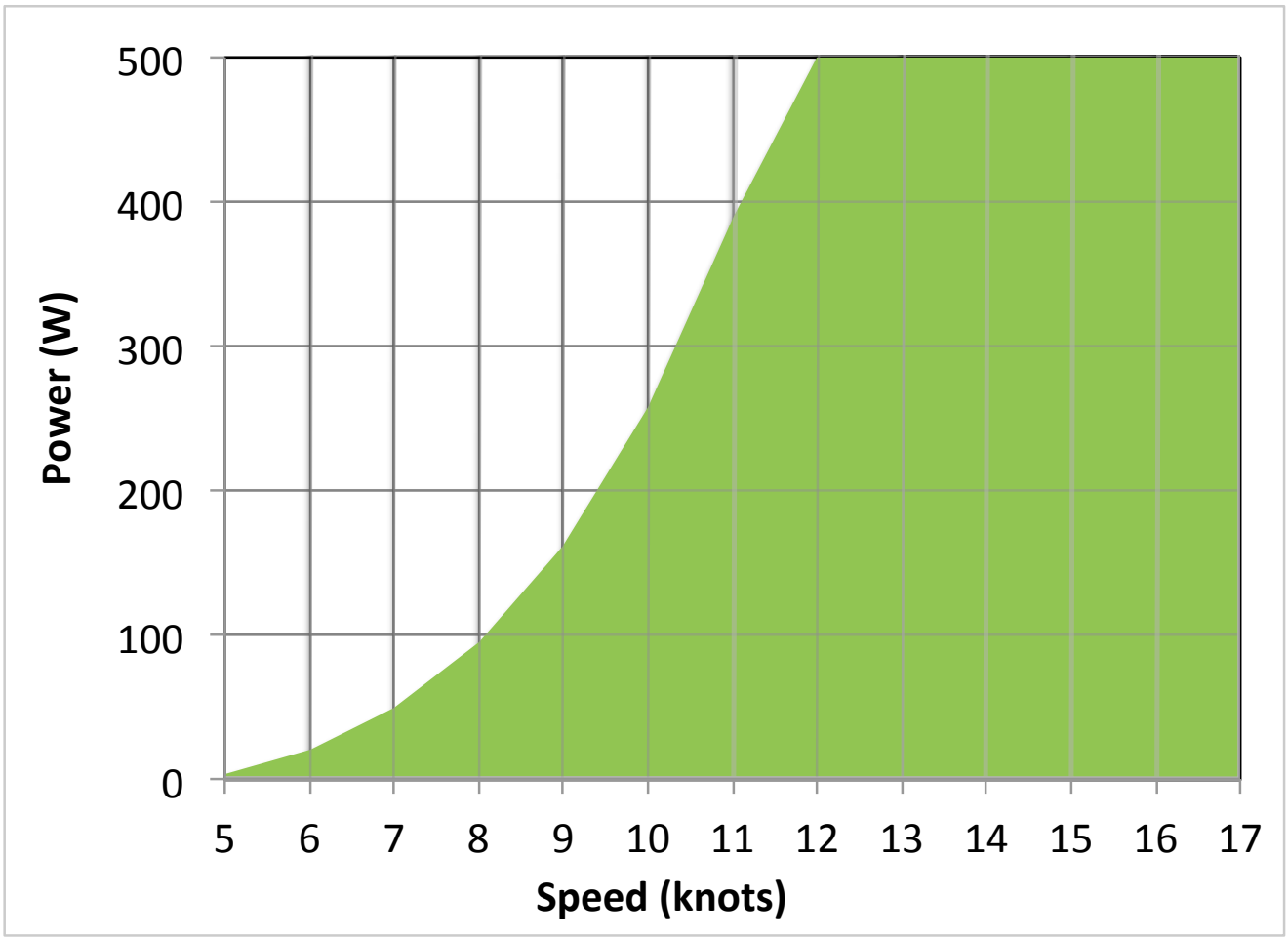
On the racing model, pales modify their incidence according to the speed of the boat and the load of batteries. In this way, the protection anti-surge brings in in service only in case of transients or safety and the drag is optimal whatever is the speed.
The regulation of pales is made by impulse when the speed of the turbine goes out of a predefined range. This regulation is made in automatic mode when the switch " manu / auto" is positioned on "auto". It is however possible to force this regulation by positioning the switch on the manual mode and by settling the slope of pales with the switch " release / pump ".

- **The converter :**

The converter is transforming the alternative voltage of the alternator in a continuous voltage compliant with batteries. This voltage is reached only when batteries are full. In normal functioning, the in board voltage is lower than 14,3V or 28,6V.

7.3. Performances

As detailed in Chapter *Placing the device on the transom*, the performance strongly depends upon the right location on the transom, the quality of water flow and the speedometer calibration.



8. MAINTENANCE

The hydrogenerator has been designed for offshore races and benefits from the latest technology for its reliability. Metallic parts are made either in specially treated aluminium or in stainless steel A4.
The best sealing is obtained with a hi-tech ceramic-carbon gasket used in industry. These gaskets have a lifetime of several thousands of hours and will painlessly support a circumnavigation.
The body is filled with lubricating oil that is slightly pressured to prevent any water seepage. In addition, the alternator is factory immersed in a resin that encapsulates electrical conductors. Should dampness occur, the electric parts are resistant to damage.

Therefore, this device does not need any particular maintenance other than cleaning external parts.

- Regularly clean the body of the device
- Check regularly that the device mountings are tight
- Check that all the electrical connections are tight and clean (not corroded)
- Do not operate the hydrogenerator with damaged or unbalanced propeller blades. This might cause a premature wear, or a break down. Replace the propeller as soon as possible.

9. SPARE PARTS

WS-H-C- 001	Cruising hydrogenerator
WS-CV-C-12	12 Volts converter
WS-CV-R-24	24 Volts converter
WS-K-C-001	Aluminium cradle
WS-H-P- 001	3 blades propeller
WS-HPU-12-100	12V Hydraulic Pump
WS-HPU-24-100	24V Hydraulic Pump

10. FREQUENTLY ASKED QUESTIONS

10.1. Operation

- What power can I expect?

The power generated increases at the cube of the speed (V3). At 7 knots, the output power is about 120W (or about 10Amp on a 12V battery). At 11 knots, the system produces 4 times more power, i.e. 480W (about 40A on a 12V battery). These figures are instantaneous measurements and averages might be different according to the condition at sea.

- What speed loss is to be expected?

We currently don't have any reliable data on the effective drag of the device, or about the speed loss it generates. Our immersion and lifting trials at constant speed have not shown any substantial difference on the speedometer.

- What happens when the batteries are charged?

The electronic regulator automatically charges the batteries. When the batteries are fully charged, the propeller pitch decreases, which diminishes the drag. From that point on, the system maintains the charge and covers onboard electricity consumption.

- What happens in case of impact?

The lifting system allows inserting a fuse that will release the device in case of impact. However, risk of direct impact on the device is minimal given its position on the transom, aft of the keel, centerboard, and rudder.

- Can I use the device while I run my boat main engine?

The system in not designed to replace the alternator of your engine. It can nevertheless be used while operating your main engine, though the output may be lower because of the engine propeller turbulences.

10.2. At dock

- What should I do with the device in harbor?

You may either leave the device on the transom in lifted position, or stow it away in your cockpit locker if you own a portable model.

11. WARRANTY

Conditions and coverage: Our products are designed for specific conditions of use that our customers must respect. They are guaranteed against any defect of manufacturing, during 2 years from the date of purchase of the dealer.
The guarantee is limited to the replacement of the defective components or, if necessary, of the whole device, by simple exchange on reception of the litigious part.
In accordance with the common right, the purchaser will have the burden to proof the anteriority of the latent defect, which he calls upon.
The returned device or parts will have to be accompanied by the warranty return form (see below) dully documented with the name and address of client, date of purchase, type of boat, description of defect or malfunction of the part, and description of the conditions of use of the system.

The returned systems or components are accepted only in the event of prior written agreement. All returns items will have to be carried out in carriage paid. If the replaced product proves to be due to a defect included in the guarantee, then the expenses of return will be refunded. In no case, the returned systems or components will be refunded but only replaced.

Situation not covered by the guarantee:
This guarantee does not apply if the system:
- Suffered from accidents, underwent modifications or repairs without authorization,
- Was not installed by a professional installer and according to the procedure specified by WATT&SEA in the installation manual supplied with the products,
- Was
    - Was inadequately installed and maintained or use in overload conditions
    - Abused or neglected

The guarantee takes into account neither the failures resulting from the simple wear or the normal ageing of the structures and materials, nor the stripes, star-cracks or cracks, which would appear at the time of a shock.

In no case WATT&SEA will be responsible for the special, fortuitous or indirect damage.

If you encounter a problem with your WATT&SEA product: Get in touch with your dealer/installer to help you to solve the problem.

12. FORM FOR WARRANTY RETURN

Owner	
Name:	Phone number:
Address:	Email:
Post code:	Country:
Date of purchase of the hydrogenerator	Type of boat:
Serial N° (on the installation manual) - - of the hydrogenerator : - of the converter :	Type of fixing on the transom (if custom made specify):
Conditions of use (frequency of using / specific conditions having created the defect) :	
Defect noticed:	
Signature:	Date:

Retailer / Installer	
Name:	Phone N°:
Address:	Email:
Post code:	Country:
Date of purchase of the hydrogenerator:	Is the defect evident?
Is the installation in conformity with the instruction manual?	Contact details of the installer:
Defective parts to be replaced:	
Signature:	Date:

N° of authorization for after sales return :